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Physical activity and sedentary time in Physical Education classes and their association with cardiorespiratory fitness in students

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ORIGINAL ARTICLE

ABSTRACT

This study aimed to evaluate the intensity and duration of activities in Physical Education classes and to test their association with cardiorespiratory fitness. It is a cross-sectional study with 614 schoolchildren (51% girls), aged 10 to 17 years old, evaluated by accelerometers in 100 Physical Education classes in Pinhais, Southern Brazil. The intensity of the activities was determined by accelerometry (Actigraph, model WGT3X). The time spent in each intensity (sedentary, light, moderate, intense and very intense) was evaluated. Cardiorespiratory fitness was determined by the Léger test 20 meters. The average duration of the classes was 31.5 minutes (SD = 4.3). On average, boys and girls passed 23.8% and 16.9% ($p < 0.05$) of a class in activities of moderate and vigorous intensity, respectively. The correlation between time in physical activity and cardiorespiratory fitness was significant in boys (Light, moderate and vigorous, respectively: $r = 0.12$, $p = 0.04$, $r = 0.12$, $p = 0.04$, $r = 0.15$, $p = 0.009$). In conclusion, the low correlation between physical activity time in Physical Education classes and cardiorespiratory fitness reinforces the discussion about how this subject can contribute to the public health in young population.
Keywords: motor activity, physical effort, cardiorespiratory fitness.

INTRODUCTION

The Cardiorespiratory fitness (CF) is an important indicator of the health of the young population (Anderssen et al., 2007; Lobelo, Pate, Dowda, Liese, & Ruiz, 2009). Studies have pointed out that low CF is associated with the development of several cardiovascular risk factors, such as overweight and hyperglyceridaemia (Lobelo et al., 2009), high concentrations of total cholesterol (Wedderkopp, Froberg, Hansen, Riddoch, & Andersen, 2003). There is also evidence that this association of CF with cardiovascular risk factors extends into adult life, contributing to the development and worsening of chronic-degenerative diseases (Katzmarzyk, Church, Craig, & Bouchard, 2009).

Among the different factors that may influence the CF, from genetic to environmental factors (Barbieri, 2010), stimulating an active lifestyle represents an important contribution to the development and maintenance of the individual's CF (World Health Organization [WHO], 2010). Evidence with accelerometer measurements shows that moderate and/or vigorous intensity physical activity (MVPA) is positively related to CF, with moderate intensity having a weaker relationship with CF than vigorous intensity (Gutin, Yin, Humphries, & Barbeu, 2005), which is based on the results obtained by Martinez-Gomez et al. (2010).

One aspect that seems not yet elucidated is the contribution (or relation) of the PA performed during Physical Education classes in the CF. The school has been perceived as the better space for the promotion of PA through bodily practices and the reduction of sedentary behaviours (Hoehner et al., 2013), and Physical Education (PE) classes have been understood as a time and space for contribute to the increase of time in PA of different intensities, both inside and outside the classroom (Araújo, Brito, & Silva, 2010). Experiences at school during PE classes may result in the appropriation of active behaviour, especially when classes are pleasurable and assist in engaging in regular PA

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(Hoehner et al., 2013). In Brazil, studies on the time in PA at different intensities in the Physical Education classes were performed previously (Guedes & Guedes, 1997; Hino, Reis, & Añez, 2007) and found that the composition of Physical Education classes is fundamentally of light or sedentary activities. A study with PA measured by accelerometry reinforced these findings, indicating that 22.6% of the time of PE classes were in sedentary activities, and that only 32.7% of classes were composed by PA of moderate to vigorous intensity (Kremer, 2010).

One question is whether the time in PA during Physical Education classes is related to an important attribute related to health and the active lifestyle among school children: the CF. The PA time in Physical Education classes seems to have little contribution to time in out-of-school PA (Kremer, 2010), but studies that analyse this relationship with CF are unknown in the national literature. Collecting evidence on this aspect may contribute to the organization of PE classes that aim to increase active participation in Physical Education classes, as well as whether this participation is justified by the relation with a health aspect, such as CF.

METHOD

This study presented a descriptive and correlational cross-sectional survey, and was carried out with students from the state public network of Pinhais, Paraná, Southern Brazil (human development index of the municipality of 0.761). In 2014, 7.058 individuals were enrolled in elementary school classes and 5.196 in high school in the 13 schools belonging to the municipality (SEED, 2014).

Participants

The study participants consisted of students of both sexes, enrolled in the 13 existing elementary schools and two high schools. Altogether, 420 classes were eligible in the state public education system of the city of Pinhais, Paraná, with students aged 10 to 17.9 years.

The Gpower software test was used a priori to calculate the sample size in the test of hypotheses for correlation, assuming an effect size of 0.15 as a function of not having found previous studies that used these variables, alpha of 0.05 and power of 0.80. In addition, to correct the error related to the sample selection process according to recommendations for studies with cluster sampling (classes), a delineation effect of 1.2 was added, producing a minimum sample of (n=408). Following the sample calculation, 30% were added for possible losses and refusals. Therefore, the total sample was 537 students.

The selection of the sample of this study was made from the proportional stratified random sampling process. Initially, all the schools participated in the sample, in which the classes were the strata, being the separation of the classes by grades. Next, a draw of the classes was carried out. The number of classes per grade was defined by dividing the total number of students required for the study by 30 (the average number of students per class). In the second stage, the schools were drawn from the sequence numbering of the classes by grade (from the 6th year of elementary school to the 2nd year of high school) and by school, this procedure was carried out for all schools. A random draw of the total of classes was carried out, where the selection of the class indicates the school. To solve the problem of possible losses and refusals of students in each class, a new class of the same grade was drawn to compose the necessary number of students to be evaluated. In the end, 50 classes were evaluated in two classes of thirteen state schools, representing 100% of schools in the city of Pinhais-PR, in the total of 100 evaluations with accelerometers during classes in the schools evaluated.

The students who presented the written informed consent form (WICF) signed by the parents/guardians and the agreement signed by the students at the time of data collection, aged less than 10.0 years old and over 17.9 years old. Schoolchildren with physical disabilities who could have compromised PA levels were excluded from the sample.

Instruments and Procedures

The assessment of the intensity and duration of PA in PE classes, and total PA was performed using accelerometry with the Actigraph

Accelerometer, WGT3X (ActiGraph, Pensacola, FL). The students were instructed to use the accelerometer for seven days for monitoring, including the two days of the weekend to identify the PA behaviours (Trost et al., 2002). Schoolchildren were instructed to wear the accelerometer immediately after waking up, only to be withdrawn at times of bathing, water activities and periods of sleep. To ensure greater adherence to the use of the accelerometer, schoolchildren were contacted via cellular message and telephone calls made by the persons responsible, as well as pamphlets with instructions on the use of the devices. The accelerometer was positioned using an elastic band in the hip aligned to the average axillary line of the students and was programmed with epoch of 60 seconds.

For the present study, the calculation of the duration of the PA intensities in two PE classes in the same week was used, based on the monitoring of the beginning and end of the 45-minute classes. The class was selected at the time the class draw was held. The presence of the participants in the class was controlled by the teacher's presence list and the PE teachers were not informed about the main content of the research so as not to influence the normal progress of their classes. Nevertheless, the students were not monitored by the evaluators during PE classes and the activities developed were not recorded. This care was taken so that the presence of the evaluators did not influence the intensity of the PA during the classes, as well as the type of teacher's class, that could modify its practice motivated by the presence of the evaluators and the knowledge about which variables would be measured. The beginning and end time of the class was considered the same as informed by the direction of the school and the beginning of the activity schedule was reported by the students. The total time in PA outside Physical Education classes was used as a control variable.

The CF was estimated from the prediction of maximal oxygen consumption (predicted VO_2max), by performing the 20-meter back-and-forth test (Léger, Mercier, Gadoury, & Lambert, 1988). The students were classified according to the distribution in appropriate and inadequate ACR, according to cut-off point for both sexes (FITNESSGRAM, 2014).

Some control variables were evaluated. For the socioeconomic classification of the family, the criterion Brazil (ABEP, 2008) was used, this criterion aims at estimating the purchasing power of the individuals and families and the degree of education of the head of the family, separating in the socioeconomic classes (A1, A2, B1, B2, C1, C2, D, E). The biological maturation was determined using the self-evaluation method of pubic hairiness (Tanner, 1962). The test was applied by 1 (one) evaluator of the same sex as the evaluated one. All evaluations occurred in an individualized way to preserve the intimacy of the students. In order to obtain BMI, height and body mass were collected using standardized criteria (Guedes, 2007) and BMI was determined by calculating the ratio (division) between the measures of total body mass in kilograms by height in meters raised to the square. BMI was classified according to the criteria proposed by the cut-off points for sex and age (Cole, Bellizzi, Flegal, & Dietz, 2000).

Ethical aspects of the study

For the collection of data, the norms that regulate the research involving human beings of the National Health Council (resolution nº 466/2012) were followed, being evaluated and approved by the Research Ethics Committee of the Federal University of Paraná under opinion nº 638.917.

Statistical analysis

For statistical analysis we used the simple and relative frequency distribution for the characterization of the sample, the normality of the data was tested using the Kolmogorov-Smirnov test. Considering the non-normality of the data, the comparison between the sexes in the percentage variable of the duration in the activities in different intensities in the two PE classes was performed using the U test by Mann Whitney. The relationship between PA intensity and duration within the two PE classes with the

CF was performed by means of a partial correlation, controlled for socioeconomic status, maturational stage, BMI and total time of PA in moderate to vigorous intensity.

The association between the percentage of time spent in Physical Education classes in activities of different intensities and the classification of CF to health was estimated through multivariate logistic regression. For that, the odds ratio and its 95% confidence intervals (CI 95%) were calculated, with adjustments for potential confounding variables (maturational stage, economic condition, BMI and time in MVPA beyond Physical Education class). The percentage of time in Physical Education class was continuously used to avoid loss of statistical power in the analyses in the categorization of the independent variable.

All analyses were performed with the total sample and by sex. The SPSS Statistics 21® software was used, with the significance level being set at $p < 0.05$ in all analyses.

RESULTS

The final sample consisted of 614 students, 312 girls (50.8%) and 302 boys (49.2%). In the total sample, 70.0% of normal weight, 23.0% were overweight and 7.0% were obese. In the analysis of the maturational stage, 37.0% of the students were in the maturational stage 4 (four) and in relation to the socioeconomic classification 59.28% of the students belonged to the "C" classes (Table 1).

The description of the time in physical and sedentary activities in Physical Education classes can be observed in Table 2. Most of the time of Physical Education classes was in sedentary activities (62.2% and 71.1% for boys and girls, respectively). The time in vigorous physical activities ranged from 0.0% to 30.0% in boys and from 0.0% and 25.3% in girls.). The time in very vigorous physical activities ranged from 0.0% to 18.2% in boys and from 0.0% and 15.1% in girls.

Table 1

Characterization of the sample of elementary and middle school students of the state education network of the municipality of Pinhais-PR, 2014 (n = 614)

	Boys	Girls	TOTAL
Age (médian±SD)	14.1±1.64	13.75±1.57	13.88±0.71
Nutritional status (%)			
Normal	229(53%)	200(47%)	429(70%)
Overweight	55(39%)	85(61%)	140(23%)
Obesity	18(40%)	27(60%)	45(7%)
Biological Maturation			
Stage 1	4 (18%)	18(82%)	22(4%)
Stage 2	17 (27%)	45(73%)	62(11%)
Stage 3	83 (42%)	115(58%)	198(32%)
Stage 4	136 (59%)	94(41%)	230(37%)
Stage 5	62 (61%)	40(39%)	102(17%)
Socioeconomic Classification			
Class A	13(100%)	0(0.0%)	13(2%)
Class B	153(97%)	4(3%)	157(26%)
Class C	119(32%)	246(68%)	364(59%)
Class D	17(22%)	59(78%)	76(12%)
Class E	0(0%)	4(100%)	4(1%)
Cardiorespiratory Fitness			
Adequate	73%	59%	348(57%)
Inadequate	27%	41%	266(43%)

The correlation between the time in the intensities of PA in the classes and CF was significant only for the boys in LPA, MPA and VPA ($r = 0.12$; $p = 0.04$, $r = 0.12$; $p = 0.04$, $r = 0.15$; $p = 0.009$, respectively), indicating that the boys who engaged for the most time at these intensities had higher values of VO_2max (Table 3).

Table 2

Comparison between girls and boys in the various intensities and duration of PA in the two PE classes of the state schools of the municipality of Pinhais-PR, in the year 2014 (n = 614)

Activities	% of the class in physical or sedentary activities		p
	Boys - Median (mín-máx)	Girls - Median (mín-máx)	
SA - PE	62.2%(0.0 – 100.0)	71.1%(0.0 – 90.0)	<0.001
LPA - PE	11.1%(0.0 – 100.0)	10.5%(0.0 – 38.1)	0.09
MPA - PE	17.7%(0.0 – 91.1)	12.2%(0.0 – 82.2)	<0.001
VPA – PE	0.0%(0.0 – 30.0)	0.0%(0.0 – 25.3)	<0.001
MVPA - PE	0.0%(0.0 – 18.2)	0.0%(0.0 – 15.1)	0.270

SA (Sedentary Activity), LPA (Light Physical Activity), MPA (Moderate Physical Activity), MVPA (Very Vigorous Physical Activity), PE (Physical Education).

Table 3
Partial correlation of duration of PA intensities in classes with CF

Activities	VO_2maximum (ml.kg.min)		
	Total (n=614)	Boys (n=302)	Girls (n=312)
SA-PE	- 0.12*	0.02	- 0.02
LPA-PE	0.05	0.12*	04
MPA-PE	0.10*	0.12*	- 0.04
VPA-PE	0.14*	0.15*	- 0.02
MVPA-PE	0.00	0.04	- 0.03

* p<0.05, Control variables (Maturity Stage, BMI, MVPA). SA (Sedentary Activity), LPA (Light Physical Activity), MPA (Moderate Physical Activity), VPA (Vigorous Physical Activity), MVPA (Very Vigorous Physical Activity), PE (Physical Education). Correlation was time-controlled in MVPA outside of PE classes.

Table 4
Association between weekly time in physical activities in Physical Education classes and the classification of cardiorespiratory fitness in schoolchildren - Bold values indicate statistical significance (p<0.05).

% Duration in activity of different intensities	Classification of CF					
	Total (n=614)		Boys (n=302)		Girls (n=312)	
	Adequate CF		Adequate CF		Adequate CF	
	OR (IC 95%)*	p-value	OR (IC 95%)*	p-value	OR (IC 95%)*	p-value
SA_PE	1.00 (0.99; 1.00)	0.16	0.99 (0.99;1.01)	0.099	0.99 (0.98;1.00)	0.22
LPA_PE	1.01 (0.99; 1.03)	0.09	1.00 (0.98; 1.03)	0.90	1.03(1.00;1.06)	0.04
MPA_PE	1.01 (1.00; 1.02)	0.06	1.01(1.00; 1.03)	0.04	1.00(0.98; 1.01)	0.84
VPA_PE	1.06 (1.00; 1.12)	0.04	1.08(0.99; 1.17)	0.07	1.00(0.92; 1.10)	0.83
MVPA_PE	1.05 (0.90; 1.24)	0.52	1.22(0.75; 2.00)	0.42	1.02(0.85; 1.21	0.86

In the total sample, only the percentage of the PE time in VPA presented a significant association with the CF adequate. After adjustment for control variables, a longer time in VPA in Physical Education classes was associated with a greater chance of having a CF adequate. The MPA showed a non-significant tendency (p = 0.06) to be associated with CF. In the gender analysis, the percentage of time in the Physical Education class in MPA was positively associated with a greater chance of having the ACR adequate in boys. The VPA showed a non-significant tendency (p = 0.07) to be associated with CF in boys. However, only the percentage of PE time in LPA was positively associated with a greater chance of having CF adequate in girls (Table 4).

DISCUSSION

In the analysis of the results regarding to the association between the duration of the intensities of PA in the PE with the CF, a significant relationship was found for boys in LPA, MPA and VPA, indicating that boys who spent more time in these intensities inside the PE classes had a higher CF, independent of the PA performed outside the school. Regarding the girls, no significant relationship was found in the PA intensities.

When we compare the times in the various PA intensities in PE classes, girls were involved in a higher proportion of sedentary PA than boys (71.1% and 62.2%). Kremer (2010), showed that only 22.6% of PE class time was in sedentary PA, and this difference in relation to the results obtained may have been due to the presence of PE teachers and researchers among the students during the process of the mentioned study, which did not occur in the present study. Moreover, the study by Hino et al. (2007), also found that girls spend more time in sedentary activities during class, as observed in the present study.

The results found in this study indicate that, on average, less than 20% of the time of PE classes, around six minutes, the students were in MVPA. Physical Education classes tend to have limited durations (the average duration of the classes was about 30 minutes, when, in theory, the classes should take 50 minutes), mainly due to the processes related to the organization of schoolchildren. Some studies (Hino et al., 2007; Kremer, 2010) identified that much of the class time was used by teachers to

guide activities, transition and take attendance, which may have contributed to the great time in SA and LPA, which also occurred in the present study, indicating that PE classes apparently do not have their time entirely used.

The low proportion of time spent on the recommended intensities to ensure the health of the young population - MVPA - (WHO, 2010), the short duration of these stimuli and the high time in sedentary PA are important findings, but the causes that lead to this outcome are still few studied. Cultural differences, educational legislation, and ethical procedures in the studies affect the curriculum in the number of PE sessions at the school and in the content described may explain the low relationship found in the duration of the various PA intensities in PE classes with the CF. This short duration of MVPA seems to be insufficient to be a contribution in motor/physical aspects (including CF).

The findings of this study may contribute to the organization of PE classes, helping teachers to rethink the organization of activities, giving greater intensity and duration of MVPA, as well as motivating students to participate in the activities, creating opportunities for all to take part. Create strategies to reduce the transition time between classes, as well as in the optimization of the spaces destined to take attendance and the explanations of the activities. Finally, it may be suggested that continuing teacher training, it is also necessary to increase the efficiency and effectiveness of PE classes in primary and secondary education.

Given the health benefits of regular PA practice (Strong et al., 2005), PE classes are important in school life so that suggested levels of PA are achieved (Mckenzie et al., 1996). It is still necessary that students have a more active participation in PE classes by increasing the duration of PA intensities in PE classes, being motivated with interesting classes which would result in improvements in CF and health.

In particular, there is a need for reflection on the proposed alternatives of physical activities that compose the Physical Education classes and that are directed to the girls. The low MVPA time during classes and the lack of correlation with the CF indicate that stimulating the regular practice of PA in PE and how it can contribute to health attributes in this population subgroup should be a topic of discussion in the training of teachers who work in this context. This indicates that the differences between boys and girls in weekly PA are mainly due to the difference in participation in intense PA. As the research results are consistent, it is evident the need to create intervention programs in the promotion of PA, where we have attention with the girls in all the age groups.

The present study was important because it includes, in an objective way, the activities of different intensities that compose the PE classes, which brought important contributions to the discussion of the composition of the PE classes and how it can be associated with health attributes in the school population. Nevertheless, the correlations controlled by potential confounding variables related to CF (such as maturational stage and BMI), as well as the time in PA outside the PE class brought robustness to the inferences of the study. Finally, the inclusion of a probabilistic sample also supports the extrapolations of these results to the population of interest. One limitation of this study was the inclusion of schoolchildren only from the public network of a municipality of Paraná, which makes it difficult to extrapolate the findings to other populations and educational networks (such as private schools). The CF measurement by field test, although it is well accepted in the literature and with acceptable validity (Ortega, Ruiz, Castillo, & Sjöström, 2008), is not a direct measure of oxygen consumption and, therefore, is susceptible to measurement errors. Finally, it is recognized that there was no detailing of the types of activities (games, free classes, plays, among others) that were carried out during PE classes, what could subsidize deep discussions about the time in sedentary and physical activities and the interests of schoolchildren.

CONCLUSION

The present study observed that more than 60% of a PE class is composed of sedentary activities, whereas less than 20% is composed of activities that correspond to the recommended health activities (MVPA) in the young population. The correlation between time in PA in PE and the CF was significant only among boys. This low correlation between the time in physical activities in the classes of Physical Education and the cardiorespiratory aptitude reinforces the discussion about how this discipline can contribute to the health of the young public. It may also show that only PE classes in the current model are not sufficient to achieve the recommended PA levels for health benefit gains in this age group. It is hoped that the results of this research contribute to a professional reflection on the organization of activities and how to motivate the students to participate in the activities in the PE classes.

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